

Claims

1. A process for producing a group III nitride semiconductor substrate, characterized in that the process comprises steps of:
 - forming a film containing metal element on a base substrate,
 - 5 forming a group III nitride semiconductor layer including region of voids therein on the metal element-containing film to be brought into direct contact therewith, and
 - peeling said base substrate with use of said region of voids as the site for peeling to take it away.
- 10 2. A process for producing a group III nitride semiconductor substrate claimed in Claim 1,
 - wherein said metal element-containing film contains a metal element possessing a decomposing action on said group III nitride semiconductor.
- 15 3. A process for producing a group III nitride semiconductor substrate claimed in Claim 2,
 - wherein said metal element is a transition element.
4. A process for producing a group III nitride semiconductor substrate claimed in Claim 2,
 - 20 wherein said metal element is scandium, yttrium, titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten, rhenium, iron, ruthenium, osmium, cobalt, rhodium, iridium, nickel, palladium, manganese, copper, platinum or gold.
5. A process for producing a group III nitride semiconductor substrate claimed in Claim 4,
 - 25 wherein said metal element is titanium, zirconium, hafnium, tantalum, platinum, cobalt or nickel.

6. A process for producing a group III nitride semiconductor substrate, characterized in that the process comprises steps of:

forming a film containing metal element on a base substrate,
growing a first group III nitride semiconductor layer on the metal

5 element-containing film to be brought into direct contact therewith,

heat-treating said metal element-containing film and said first group III nitride semiconductor layer at a temperature higher than said growth temperature for the first group III nitride semiconductor layer to form region of voids in said first group III nitride semiconductor layer,

10 forming a second group III nitride semiconductor layer on said first group III nitride semiconductor layer, and

peeling said base substrate with use of said region of voids as the site for peeling to take it away.

7. A process for producing a group III nitride semiconductor

15 substrate claimed in Claim 6,

wherein said growth temperature for the first group III nitride semiconductor layer is within the range of 400°C or higher but 800°C or lower.

8. A process for producing a group III nitride semiconductor

20 substrate claimed in Claim 6 or 7,

wherein the heat treatment of said metal element-containing film and said first group III nitride semiconductor layer is conducted at a temperature of 900°C or higher but 1,400°C or lower

9. A process for producing a group III nitride semiconductor

25 substrate claimed in Claim 6,

wherein the thickness of said first group III nitride semiconductor layer is in the range of 20 nm or thicker but 2,000 nm or thinner.

10. A process for producing a group III nitride semiconductor substrate claimed in Claim 6,

wherein said metal element-containing film is a metal film.

11. A process for producing a group III nitride semiconductor
5 substrate claimed in Claim 6,

wherein said metal element-containing film contains a metal element having a decomposing action on the group III nitride semiconductor.

12. A process for producing a group III nitride semiconductor
10 substrate claimed in Claim 11,

wherein said metal element is a transition element.

13. A process for producing a group III nitride semiconductor substrate claimed in Claim 11,

wherein said metal element is scandium, yttrium, titanium,
15 zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten, rhenium, iron, ruthenium, osmium, cobalt, rhodium, iridium, nickel, palladium, manganese, copper, platinum or gold.

14. A process for producing a group III nitride semiconductor substrate claimed in Claim 13,

20 wherein said metal element is titanium, zirconium, hafnium, tantalum, platinum, cobalt or nickel.

15. A process for producing a group III nitride semiconductor substrate, characterized in that the process comprises steps of:

forming, on a base substrate, a metal element-containing film
25 having a fine pore structure therein,

forming a group III nitride semiconductor layer including region of voids therein on the metal element-containing film to be brought into

direct contact therewith, and

peeling said base substrate with use of said region of voids as the site for peeling to take it away.

16. A process for producing a group III nitride semiconductor substrate claimed in Claim 15,

wherein said metal element-containing film contains a metal element possessing a decomposing action on the group III nitride semiconductor.

17. A process for producing a group III nitride semiconductor substrate claimed in Claim 16,

wherein said metal element is a transition element.

18. A process for producing a group III nitride semiconductor substrate claimed in Claim 16,

wherein said metal element is scandium, yttrium, titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten, rhenium, iron, ruthenium, osmium, cobalt, rhodium, iridium, nickel, palladium, manganese, copper, platinum or gold.

19. A process for producing a group III nitride semiconductor substrate claimed in Claim 18,

wherein said metal element is titanium, zirconium, hafnium, tantalum, platinum, cobalt or nickel.

20. A process for producing a group III nitride semiconductor substrate, characterized in that the process comprises steps of:

forming, on a base substrate, a metal element-containing film, at least the surface of which is composed of a metal nitride,

carrying out treatment for elimination of the nitrogen contained in said metal nitride,

forming a group III nitride semiconductor layer including region of voids therein on the metal element-containing film to be brought into direct contact therewith, and

peeling said base substrate with use of said region of voids as
5 the site for peeling to take it away.

21. A process for producing a group III nitride semiconductor substrate claimed in Claim 20,

wherein said step of forming the metal element-containing film comprises, after formation of a metal film on said base substrate, a step
10 of treatment for nitrification of the metal film.

22. A process for producing a group III nitride semiconductor substrate claimed in Claim 20,

wherein said metal element-containing film is a metal nitride film.

23. A process for producing a group III nitride semiconductor
15 substrate claimed in Claim 20,

wherein said treatment for elimination of nitrogen is a treatment in which said metal element-containing film is exposed to a reducing atmosphere.

24. A process for producing a group III nitride semiconductor
20 substrate, characterized in that the process comprises steps of:

forming, on a base substrate, a metal element-containing film, at least the surface of which is composed of a metal nitride,

growing a group III nitride semiconductor layer on the metal element-containing film to be brought into direct contact therewith under
25 condition that a V/III ratio of raw material gas is set to be 10 or less to form group III nitride semiconductor layer including region of voids therein, and

peeling said base substrate with use of said region of voids as the site for peeling to take it away.

25. A process for producing a group III nitride semiconductor substrate claimed in Claim 24,

5 wherein said metal element-containing film contains a metal element having a decomposing action on the group III nitride semiconductor.

26. A process for producing a group III nitride semiconductor substrate claimed in Claim 25,

10 wherein said metal element is a transition element.

27. A process for producing a group III nitride semiconductor substrate claimed in Claim 25,

wherein said metal element is scandium, yttrium, titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium,

15 molybdenum, tungsten, rhenium, iron, ruthenium, osmium, cobalt, rhodium, iridium, nickel, palladium, manganese, copper, platinum or gold.

28. A process for producing a group III nitride semiconductor substrate claimed in Claim 27,

20 wherein said metal element is titanium, zirconium, hafnium, tantalum, platinum, cobalt or nickel.

29. A process for producing a group III nitride semiconductor substrate claimed in any one of Claims 1, 6, 15, 20 and 24,

wherein said metal element -containing film is formed on the whole surface of said base substrate.

25 30. A process for producing a group III nitride semiconductor substrate, characterized in that the process comprises a step of:

forming, on a base substrate, a group III nitride semiconductor

layer including a porous layer therein, and thereafter peeling said base substrate with use of the porous layer as the site for peeling to take it away.

31. A process for producing a group III nitride semiconductor substrate claimed in any one of Claims 1, 6, 15, 20, 24 and 30, wherein said step of peeling said base substrate to take it away comprises a step of cooling down the temperature of the atmosphere post to the growth of the group III nitride semiconductor layer to spontaneously peel said base substrate off.

32. A group III nitride semiconductor substrate being produced by using a process for producing a group III nitride semiconductor substrate as claimed in any one of Claims 1, 6, 15, 20, 24 and 30.